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planation of the origin of species, are adduced in the chapters which are devoted to the defence of the principle of physiological selection. The latter principle may be briefly outlined as follows : The most variable part of an organism is the reproductive system, and the variations may involve either increased or diminished fertility. If the variant, while showing some degree of infertility with the parent form, continues to be as fertile as before when mated with similar variants, there is no reason why such differential fertility should not be perpetuated. This suggestion enables us to regard many, if not most, species as the records of variations in the reproductive systems of their ancestors. When variations of a more useful kind occur in any of the other parts of organisms, they are as a rule immediately extinguished by intercrossing. But whenever they arise in the reproductive system in the way here suggested, they tend to be preserved as new natural varieties or incipient species. At first the difference could only be in respect to the reproductive systems, but eventually on account of independent variation other differences would supervene, and the variety would take rank as a true species. It is evident that this theory, if established, would solve many difficulties, and it must be admitted that the author makes out a strong case in favor of his position. He points out, for instance, that the necessity of physiological selection for the *maintenance* of existing specific differentiation cannot be denied ; for if the isolation which it implies were suddenly abolished between two allied species occupying a common area they would sooner or later become fused into a common type—if we suppose, of course, that no other form of isolation were present. "Why, then," he asks, "should it be regarded as a 'Darwinian heresy' to regard physiological selection as an important factor in the *attainment* of specific differentiation ?" It is important to notice in conclusion that while the author limits the range of Natural Selection he thereby justifies and strengthens its claim to be regarded as an essential factor in organic evolution. This is not the least important aspect of his general position.

David Irons.

Animal Intelligence. By Edward L. Thorndike. Monograph Supplement of the Psychological Review, II, 4. New York, The Macmillan Co., 1898.—pp. 109.

It has long been agreed among psychologists that animal psychology is one of the most poorly developed and unsatisfactory branches of the science. Mr. Thorndike has gone a long way to remedy its defects, to substitute experiment for observation, and to apply in practice the law of parsimony that has been universally approved in theory, but in theory only. The immediate problem was to study the function of association and imitation in the animal mind, and to determine whether concepts or more complex processes were to be found there. Experiments were made upon cats, dogs, and chicks. Hungry cats and dogs were confined in cages, the doors of which could be opened by pulling a string, turning a button, or some other simple movement. Chicks were separated from their fellows by tortuous passages, and left free to find their way back. When the animal had escaped, it was returned to confinement, and this operation was repeated until the mechanism had been thoroughly ingrained. The decrease in the time that was required to get out was a measure of the rate at which the association was formed. In every case the movement was hit upon by accident in the undefined struggles to escape, and was not the result of inference. Nor did imitation prove itself to be of any value. None of the animals would perform the movements more quickly or accurately after seeing another do the same thing, and if the suitable movement had not been discovered by chance, it was not by the help of imitation. Association is the fundamental process in the animal mind.

Some interesting results were obtained from experiments made to determine the nature of the association that gives rise to the movement. It was found that to force the animal through the movements necessary to release it, did not help it to repeat them. The animal must itself initiate the movements, or it does not acquire the power to perform them. From this it is argued that there is no association of ideas, but only an association between a sense impression and an impulse. It seems that this evidence is not unexceptionable however. For, as the author notes later, in man an act is not learned from having the member directed to its performance by another, and the same line of reasoning would show that man does not possess ideas. It seems rather that the association learned in one direction, from sensations of movement to the impulse, is not the same as from the impulse to the sensation of movement.

It is shown that animals do not need concepts to perform any of the actions that the author noted. It was found that a dog, that could release himself by pulling open a loop of one kind in one position, would pull a different loop in another place without hesitation. This, says the author, can be most simply explained, not by assuming that the dog recognized the similarity in the two cases, but by the supposition that he failed to observe the difference between them. It is an evidence of poorly developed perception, not of an incipient reason. The tricks of educated animals are reduced to associations, which, it is shown, may obtain a considerable degree of complexity, and persist practically undiminished over long periods of time. Both social consciousness and attention, in any high form, are denied to animals. All of these results, however, are restricted to animals below the primates. The opinion of the author is that monkeys show signs of imitation and other related elements of a more complicated nature, although he has so far been unable to experiment upon them.

Mr. Thorndike is to be congratulated upon the outcome of his work. He has opened a new field, where, it is to be hoped, he will have many followers.

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